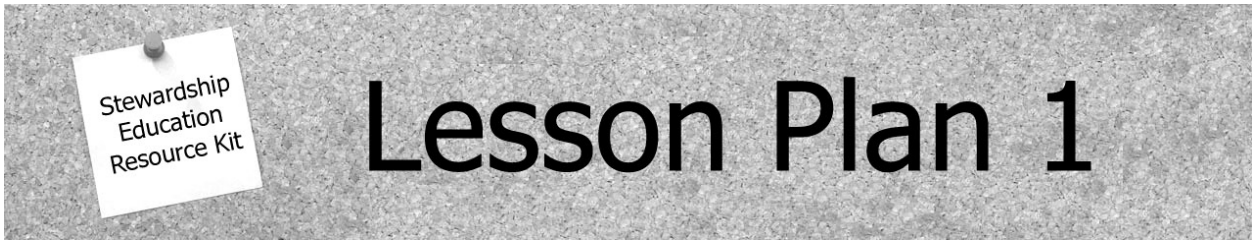


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| Title: | Lesson 1: Defining Stewardship |
| Target Grade Levels: | Grades 11-12 |
| Time Allotted: | 1–2 class periods |
| Instructor: | |
| Method of Instruction: | Lecture, group discussion, individual learning |

Instructional Goal

Upon completion of the unit, the student will be able to describe stewardship activities and issues relating to the Department of Energy's activities on the Oak Ridge Reservation.

Lesson Objectives

- Define stewardship as it relates to environmental management
- Identify stewardship issues specific to the Oak Ridge Reservation

Materials & Resources

- Glossary
- Uranium Enrichment Fact Sheet
- *A Student Summary of the Oak Ridge Reservation Stakeholder Report on Stewardship*
- Description of Video "The White Hole"

Visual Aids

- Course Overhead Transparencies—Lesson Plan 1
- Oak Ridge Reservation Map
- Video: "The White Hole"

Handouts

- Stewardship Fact Sheet
- Question List for Video "The White Hole"
- Crossword Puzzle–Oak Ridge Reservation

Vocabulary (*refer to Glossary for definitions*)

- Community steward
- Contamination
- Electromagnetic process
- Environmental management
- Gaseous diffusion
- Hazardous chemical
- Hazardous waste
- Oak Ridge Reservation
- Principal steward
- Regulatory steward
- Stewardship
- Uranium enrichment
- Volatile organic compound

| Section | Instruction | Visual Aids |
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| **1.0** | **<u>Course Goal</u>**<br><br>*Review course goal:*<br><br>Upon completion of the unit, the student will be able to describe stewardship activities and issues relating to the Department of Energy's activities on the Oak Ridge Reservation. | OVERHEAD 1: Stewardship on the Oak Ridge Reservation |
| **2.0** | **<u>Lesson 1 Objectives</u>**<br><br>*Review objectives:*<br><br>• Provide an overview of contamination on the Oak Ridge Reservation<br><br>• Define stewardship as it relates to environmental management | OVERHEAD 2: Lesson Objectives |
| **3.0** | **<u>Overview of Contaminated Areas on the Oak Ridge Reservation</u>**<br><br>*Discuss the types of contamination and their locations on the reservation. Give a very brief synopsis of why the contamination is there.*<br><br>About 10% of the land area of the Oak Ridge Reservation is considered contaminated. The waste is primarily hazardous chemicals and low-level radioactive material from the production of enriched uranium for nuclear weapons and lesser amounts from research and development activities. Most of the contamination is located around the production facilities and various burial grounds.<br><br>Some of the specific elements involved in contamination on the reservation are uranium, cesium-137, strontium-90, cobalt-60, iodine-131, and transuranic elements (elements with an atomic mass greater than uranium).<br><br>Some of the contamination on the Oak Ridge Reservation is hazardous waste, typical of industry and resulting from former waste disposal practices that are unacceptable today.<br><br>The contamination on the Oak Ridge Reservation results from uranium enrichment activities begun in the 1940s during World War II. Three facilities were built to focus on different types of activities. Y-12 was built to enrich uranium through the electromagnetic process. K-25 was constructed for the gaseous diffusion process of uranium enrichment. Oak Ridge National Laboratory houses the first full-size nuclear reactor - | Wall map of the Oak Ridge Reservation |

| Section | Instruction | Visual Aids |
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| | the Graphite Reactor. The different types of activities at the three facilities produced a wide variety of wastes.<br><br>Over time, some contamination has migrated off the reservation. This includes a volatile organic compound plume in Union Valley; mercury at East Fork Poplar Creek; cesium-137, strontium-90, and tritium in the Clinch River; and contaminated sediments in Watts Bar Reservoir.<br><br>*Ask: Can you identify on the wall map how far and in what direction you live from the Oak Ridge Reservation?* | OVERHEAD 3: Y-12<br><br>OVERHEAD 4: K-25<br><br>OVERHEAD 5: Oak Ridge National Laboratory |
| 3.1 | Why Enriched Uranium is Such a Problem<br><br>*Give a very brief overview of the enrichment process to help students understand why this material is a special concern to stewardship.*<br><br>This viewgraph shows the various techniques for uranium enrichment. To make enriched uranium, natural uranium is processed to increase the concentration of a particular type of uranium atom found in the natural ore. This type of uranium atom - called uranium-235 - comprises less than one percent by weight of the uranium as it is mined.<br><br>The enrichment processes produce large amounts of depleted natural uranium, as well as uranium-contaminated scrap metal, and a variety of other hazardous wastes.<br><br>While modern science has provided ways to neutralize or control many of these substances, it has not been able to find a solution for one critical problem: uranium and its enriched products will remain hazardous to human health and the environment for extremely long periods of time.<br><br>Radioactive elements eventually degrade to a safe level, some in as short a time as a few years. Enriched uranium, however, will be a danger for centuries. | OVERHEAD 6: Uranium enrichment processes |
| **4.0** | **Stewardship as It Relates to Environmental Management**<br><br>*Discuss in general terms why contaminated areas of the reservation will need oversight.*<br><br>The many waste products that were generated during uranium enrichment production on the reservation were typically discarded by simply dumping them into ditches or allowing them to discharge into surface waters. In the 1940s and 1950s, the hazards associated with these practices were not well known or understood. | OVERHEAD 7–8: Early waste dumping practices |

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| | As these waste products accumulated over time, it became apparent that they were polluting the environment, and actions to contain the waste seepage began. Eventually, it became necessary to clean up some of the contamination so that it would no longer be a threat to people or the environment. The responsibility for cleanup falls to the Department of Energy's Environmental Management Program.<br><br>As cleanup progressed, it was soon obvious that some materials were so hazardous and their excavation so risky and expensive that they would have to be left in place. Also, many citizens and public groups oppose the off-site disposal of contaminated wastes because of the transportation costs and risks.<br><br>Efforts are being made to keep the wastes from leaching into the environment, but no one can guarantee that these protective measures will never fail.<br><br>It will be necessary to monitor these sites for a very long time. This activity is called stewardship, and it is part of the Environmental Management Program's responsibility.<br><br>*Ask: Why is environmental management important?* | |
| 4.1 | What is Stewardship?<br><br>*Define stewardship, and point out the difference between the general definition of stewardship (e.g., stewardship of endangered species) and the environmental version.*<br><br>Stewardship, with respect to environmental cleanup, is defined as "the acceptance of responsibility and the implementation of activities necessary to maintain long-term protection of human health and of the environment from hazards posed by residual radioactive and chemically hazardous materials." | OVERHEAD 9: Stewardship definition |
| 4.2 | Why is Stewardship Necessary?<br><br>*Provide more detail about why contaminated areas will need oversight.*<br><br>We know that many areas of the Oak Ridge Reservation are contaminated from uranium enrichment activities. We also know that some of the contamination will not be cleaned up, and we understand the reasons for leaving it in place. But why is it so important that the residual contamination be watched over?<br><br>Most of the hazardous chemicals and enriched uranium | |

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| | products left on the reservation will require decades before they naturally degrade to a safe condition. Some enriched uranium products, such as uranium-235, will remain a hazard for thousands of years.<br><br>While contaminated areas will be fenced off to prevent trespass, ownership of the areas may change over time. The Department of Energy may not even be in existence 50 years from now, and whatever entity takes charge of the contaminated areas may not be fully aware of the dangers lying within. Over time, land-use restrictions on these areas may be relaxed, or knowledge about the dangers may be lost entirely. This has already happened at other contaminated sites around the country, like Love Canal.<br><br>It has become apparent to many people and organizations concerned with environmental cleanup that some mechanism will be required to make sure that the public and the environment are protected from areas containing residual contamination. Many people believe that stewardship is the best mechanism to achieve this protection. | |
| 4.3 | <u>Who are Stewards of Long-Term Stewardship?</u><br><br>*Introduce the topic of stewards, which will be discussed more in Lesson Plan 2.*<br><br>Stewards are individuals or groups responsible for stewardship activities. There are three types:<br><br>• The principal steward has legal responsibility for the contaminated land and facilities. This steward must ensure funding.<br><br>• Regulatory stewards ensure that the goals and requirements of a stewardship program are met. For the Oak Ridge Reservation, these stewards include the Environmental Protection Agency and the Tennessee Department of Environment and Conservation.<br><br>• Community stewards comprise a variety of organizations that will provide public input to stewardship. These include local organizations and governments, pubic schools, and libraries. | |
| 4.4 | <u>Where Do You Fit Into Long-Term Stewardship?</u><br><br>*Open floor for discussion and provide possible answers.*<br><br>Members of the community can: | "Student Summary of the Oak Ridge Reservation Stakeholder Report on |

| Section | Instruction | Visual Aids |
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| | • Understand the issues<br>• Help to dispel misinformation<br>• Help ensure the condition of Oak Ridge Reservation is properly recorded through such methods as maps, property transfer documents, land use planning, etc.<br>• Encourage government agencies (both local and national) to continue oversight of stewardship<br>• Participate as citizens/students in local organizations that track stewardship activities.<br><br>*Pass around the copy of the* "*Student Summary of the Oak Ridge Reservation Stakeholder Report on Stewardship." Elaborate on the source for the Student Summary—the "Stakeholder Reports on Stewardship" (see the Foreword of the Student Summary for details).*<br><br>This summary was prepared by two area high schools to help explain stewardship and the cleanup process to other area high school students.<br><br>*Ask: What do you think is the ultimate goal of stewardship?*<br><br>The ultimate goal of stewardship is to protect the public and the environment from the harmful effects of residual contamination left in place on the Oak Ridge Reservation. | Stewardship" |
| 4.5 | <u>Video "The White Hole"</u><br><br>*Distribute question list handout. Allow 10 minutes for video, time for students to complete questions, and time for discussion afterwards.* | Video "The White Hole" |
| **5.0** | **<u>Activity</u>**<br><br>*Distribute the Oak Ridge Reservation crossword puzzle as an in-class or take-home activity.* | |
| **6.0** | **<u>Lesson Summary</u>**<br><br>*Review objectives, and summarize what was learned in this lesson.* | OVERHEAD 10: Lesson Objectives |